Donn B. Cahill

AN EVALUATION OF FOREST INSECT AND DISEASE RESEARCH NEEDS IN SOUTHERN IDAHO

PART I - INSECTS

By

Southern Idaho Forest Pest Action Council

1958

The Southern Idaho Forest Pest Action Council is composed of representatives of the following organizations:

State of Idaho Department of Forestry
State of Idaho Land Department
Keep Idaho Green Committee
Southern Idaho Forestry Association
South Idaho Lumber Industry
Southern Idaho Timber Protective Association
United States Bureau of Land Management
United States Forest Service, Region 4
Intermountain Forest and Range Experiment Station
State of Idaho Fish and Game Department

TABLE OF CONTENTS

FOREWORD

Destruction caused by insects in Idaho forests and their products demandsattention. While accurate estimates of losses are not available, it is conservatively estimated that 70 million board feet of sawtimber in southern Idaho can be charged as annual loss due to insects. In addition to direct losses due to mortality resulting from insect activity there is an unmeasured loss of growth because of insect feeding, destruction of cones and seeds that hinders regeneration, and probably considerable damage to wood products.

Since its formation in 1953, the southern Idaho Forest Pest Action Council has dealt directly with insect problems. The Council led in promoting control of the pine butterfly in 1954 and the spruce budworm spray projects that started in 1955. In addition to its interest in controlling forest insects, the Council believes that much additional information is needed in order to understand the behavior of the forest insects and to improve direct control methods and to develop methods or practices to prevent outbreaks.

With this in mind the Council has reviewed the research needs with representatives of the Intermountain Forest and Range Experiment Station and has prepared this report on insect research problems.

SUMMARY AND RECOMMENDATIONS

In sizing up the research needs in southern Idaho it is well to bear in mind that the insects that present problems may display behavior patterns peculiar to this area. Although most of these insects have received some study in other sections of the country, results of those studies are not always directly applicable to southern Idaho because of differences in climate, host, or natural control factors.

Although a start has been made toward studying forest insect problems in southern Idaho the research program should be strengthened to include more of the important problems. Some of the general forest insect problems in need of research are:

1. Improvement of surveys of insect population and damage.
2. Biological control.
3. Insecticidal control.

A host of specific insects are of particular concern in southern Idaho. These are presented in order of their priority on the basis of current determinations of damage caused by them. Studies concerning them should include the following:

1. Douglas-Fir Beetle. Investigations should include a determination of annual loss trends, certain aspects of beetle flight, causes for population fluctuations, relation of population and damage, feasibility of salvage-logging for control, effect of management practices on rate of loss and studies of risk and susceptibility.

2. Spruce Budworm. Studies are needed on the effect of defoliation, dispersal characteristics, and natural control factors as they exist in southern Idaho.

3. Mountain Pine Beetle. Points that require study include epidemiology and a determination of ways to reduce loss in lodgepole pine and young ponderosa pine stands through management practices.

4. Western Pine Beetle. Problems that confront forest management concern the applicability of the California risk classification and sanitation salvage-logging to ponderosa pine and losses in second-growth and cutover stands.

5. Engelmann Spruce Beetle. Other than determining the applicability of findings in other areas, no work is needed.

6. Pine Butterfly. Major points still to be determined are the role of natural control factors and the effect of defoliation on the host tree.

7. Pine Engravers. Appraisal of damage, conditions influencing beetle populations, and management practices that might reduce damage to a minimum should receive attention.

8. Cone and Seed Insects. Little is known about these insects in southern Idaho. Studies should be undertaken to appraise the amount of seed destroyed and the species involved.

9. Wood Products Insects. We need to determine the nature and severity of damage as a basis for formulating preventive and control practices.

10. Other Insects. Besides those listed above, other insects occasionally cause considerable damage. Among this group, which are cyclical in their occurrence, are the Douglas-fir tussock moth, fir engravers, hemlock looper, lodgepole sawfly, lodgepole needle miner, and others. Some of these should be included in biological control studies.

GENERAL FOREST INSECT RESEARCH PROBLEMS

Some phases of research are common to the over-all forest insect problem. These basic problems are presented here.

FOREST INSECT SURVEYS

Importance of Problem

Surveys, which, in their simplest form, involve the detection of insect-caused damage, warn of impending outbreaks at a time when effective control measures may be taken. Surveys serve in other ways, too. When serious infestations strike, an accounting of the damage provides information needed to prepare to combat the outbreak. Supplies, manpower, and the schedule of operations are based solely on the outcome of the survey. Surveys again enter the picture after control action is completed in order to evaluate its effectiveness.

Other surveys take account of the annual drain of timber and the trends of damage. Such information is very helpful to forest managers. Often, surveys result in directing cutting into high loss areas or into areas where accelerated loss is anticipated. These surveys also provide a basis for determining the relative economic importance of the various destructive forest insects. The priority of subsequent studies, as those proposed in the report, are based largely on damage survey reports.

Another type of survey--not yet adequately developed--consists of the measurement of insect populations. Because buildups of insects usually precede expanded damage, it is logical that much damage can be

anticipated beforehand if an effective population sampling method is developed for each forest insect. Although this field is promising, work has lagged and many difficulties remain to be overcome.

The information obtainable through surveys cannot be left to guess. Estimates of damage must be obtained systematically. As yet, we do not have all of the answers at hand with respect to how the desired information may best be obtained. Many insects, each having different habits and behavior, are involved. Damage caused by several different insects may be intermingled in a single area. Several hosts are usually involved. The nature of damage varies greatly; one insect may cause defoliation while another kills its host by tunnelling beneath the bark. Added complications are presented by a difference in the rate of fading of the foliage, number of generations of the insect, and time of year when damage is most readily observed.

Along with cost considerations, which involve development of economical survey methods, there are considerations of reliability of the method and the time required to complete the survey. Each of these aspects must always be weighed in view of the particular problem at hand; for this reason we need studies of cost, reliability, and time involved in various types of surveys.

Research to Date

While there has been little research in southern Idaho, personnel engaged in actual surveys in the area have taken advantage of previous developments in other western areas. Entomologists in recent years have made important advances in survey research. Statistically sound methods have been developed for certain species in some areas.

However, some difficulty is experienced when trying to apply the various methods to southern Idaho. Some experience with use of each method is essential. Also, conditions of topography, timber type, and insect behavior differ to the point that existing methods must be studied to determine the modification needed. For example, strip or plot cruising of Douglas-fir beetle loss in southern Idaho is impractical because of very steep topography and the inaccessibility of many areas. Therefore, aerial methods seem most applicable, but the problem goes deeper than merely flying over an area and counting faded trees. Experience has shown that many faded trees are overlooked, and currently infested trees are too green to be noticed. Other similar situations could be cited.

Research Needs

Some of the work required to improve forest insect surveys in southern Idaho is not entirely a subject of research. An improved system of detection would involve the participation of all interested forest workers. Such cooperative detection surveys have been beneficial in California and

other areas. However, establishment and coordination of such a system demands much of the time of one person who can act as a clearing house for damage reports.

Most present survey methods can be improved to develop greater accuracy and can be performed more economically through additional research. Specific needs are listed below:

Ground Surveys

1. Determine the most effective methods with which to conduct various types of surveys of different insect species and forest types.

2. Determine a suitable means of evaluating insect population trends.

3. Relate insect populations and subsequent damage as a means of predicting damage and determining the need for control.

4. Investigate availability of existing sample plots and loss data as a source for estimating periodic insect-caused drain.

Aerial Surveys

1. Obtain services of trained personnel to conduct and improve aerial surveys.

2. Evaluate visual aids and recording devices. Develop aids for observers in classifying types and degrees of damage. Determine the date and degree of coverage necessary for different insect species.

3. Study the use of aerial photography as a means of measuring insect damage. Determine the extent of ground checking necessary to verify aerial estimates.

4. Determine the best altitudes for flying for most effective visual and photographic surveys.

BIOLOGICAL CONTROL

Importance of Problem

All forest insects have natural enemies. These enemies consist largely of parasites that develop within them, insects that feed upon them, other animal predators such as birds and rodents, or diseases that often produce startling reductions during epidemics. These natural enemies are constantly at work, but like their hosts they vary in numbers and effectiveness.

Artificial control methods not only destroy bark beetles and defoliators but may also destroy the beneficial parasites and predators. Greater knowledge of the natural enemies of the forest pests might make it possible to time control operations to do the least harm to the beneficial species. It is conceivable that proper analysis of the effectiveness of artificial control techniques might result in a decision not to use them where it appears that natural control is probable within a reasonable period.

Research to Date

Biological control has been employed with increasing frequency to control insect damage. Water suspensions of virus disease of the European spruce sawfly have been very effective in controlling that pest in the Lake States and Canada. Another virus has been used to control the Great Basin tent caterpillar. Although not a forest insect, the Japanese beetle is controlled effectively by introduction of spores that cause the bacterial milky diseases of that insect. Applied biological control of many of our forest insects has not been attempted or is imperfectly developed. However, infectious diseases have been observed to kill many of them. It appears that it only remains a matter of time before successful applied biological control methods will be developed for more forest insects.

Research Needs

A workable means of applying biological control to any of our forest insects would be very valuable. The defoliators, as a group, are especially adapted to this type of control. Needed action:

1. Isolate contagious insect diseases that may be present in southern Idaho's forests.

2. Test various disease formulations by various modes of application against specific forest insects.

INSECTICIDAL CONTROL

Importance of Problem

Damage caused by some forest insects, especially defoliators like the spruce budworm, had to be left to run its course until organic insecticides became available in recent years. Since the development of DDT, many millions of acres of budworm infestation have been sprayed whereas practically nothing had been possible to stem such damage before that time. Similarly, tremendous numbers of trees infested with the Engelmann spruce beetle and other bark beetles have been sprayed at relatively low cost with hand sprayers. Tests of many insecticides and various formulations have been conducted to determine their effectiveness against most of the destructive forest insects. One or more insecticides have proved

economical and effective against most insects. However, continued improvement in effectiveness, cost or convenience of formulation has been achieved; this suggests that further returns should result from additional research. Chemical manufacturing companies are constantly and rapidly developing new products. In fact, the work required for the systematic screening of each new insecticide would be greater than is possible at present in southern Idaho. Nor would such activity be desirable because personnel at other laboratories are currently engaged in the same work.

Research Needs

Although there appears to be no need for centering toxicological work in southern Idaho, it might be desirable to undertake work along the following lines as new insecticides become available:

1. Develop and conduct field tests of the more promising chemicals.

2. Determine the most satisfactory formulations for specific insects in the area.

3. Determine the effect of insecticides used during control projects on fish, aquatic insects, and natural control organisms.

SPECIFIC FOREST INSECT PROBLEMS

In listing research needs for specific insects, species have been treated here in order of priority. Priorities are based on the relative damage caused by each insect species as currently determined. Increased knowledge to be gained through the recently established research program may change some of these priorities.

Current research in southern Idaho concerns only the Douglas-fir beetle, spruce budworm, pine butterfly, and western pine beetle. The studies involving the first two insects are the only ones that approach adequacy. They were begun on a limited basis in 1955 and expansion is planned as work proceeds. It has been difficult for the two Federal entomologists in this area to undertake as much research as would be desired because of heavy commitments involved with 4 successive large aerial spraying projects that began in 1954.

The pine butterfly study involves periodic determination of loss of increment in trees defoliated during the 1953-1954 outbreak. Study of the western pine beetle is located in the Boise Basin Experimental Forest near Idaho City. Trees have been risk-rated, using the California system, in order to determine whether there is a tendency for selection by the beetles. In order to be adequate, further work is needed, especially to determine any modification of the risk-rating system which is indicated for ponderosa pine in southern Idaho.

Douglas-fir Beetle

This insect is the most important tree killer in southern Idaho. The behavior of the beetle and the nature of damage differ in coastal and interior stands. Outbreaks of the beetle in coastal areas usually require some evident contributing cause such as windthrown trees in which it breeds and amasses great numbers. When such material becomes exhausted or unsuited for the development of broods, the beetle often attacks and kills groups of nearby standing trees. Damage may be tremendous, but these infestations normally subside in a few years.

In interior stands the beetle is more aggressive. Although contributing causes may be associated with outbreaks, many infestations appear to start in uninjured timber and sweep over large areas. Once started, they may subside slowly.

Research to Date

Some research was conducted between 1931 and 1933 in the northern Rocky Mountain Region and more recently in the Pacific Northwest and in Canada. The early studies resulted in rather complete information concerning the biology and seasonal history of the beetle. The other studies have largely involved host and stand conditions associated with damage and some aspects of natural control.

No practical direct or indirect control measures have been developed. Chemical control is effective in interior stands, but it is still too expensive in most forests. Salvage logging of infested trees in small areas seems feasible because it has been applied successfully against other bark beetles.

Factors that favor buildups of this beetle have been studied only sparingly. The silvicultural relationship and the effects of defoliation, fire, logging and windthrow need further study, especially in interior stands.

Flight habits of this beetle remain largely unexplored. Many natural control factors have not been fully identified, and only exploratory work has been done toward evaluating their effectiveness.

Our present knowledge of this important insect needs to be vastly increased before we can hope to reduce the damage caused by it.

Research Needs

It is recommended that investigations be undertaken on the following:

1. Appraisal of the Douglas-fir beetle problem in southern Idaho. Develop and establish a survey system for recording loss and infestation trends.

2. Additional study of the biology of this beetle. Obtain information concerning emergence and flight periods in relation to weather, temperature, and altitude. Determine how far these beetles fly under normal and under unusual circumstances. Investigate what constitutes attractive influences and determines direction of flight.

3. Epidemiology. Determine the causes for increases and decreases in populations. Investigate and evaluate such natural control factors as parasites, predators, and disease during the outbreaks. Explore the role of windthrow, slash, fire, and defoliation in population buildups.

4. Relate beetle populations and damage as a means of anticipating loss and determining whether control is needed.

5. Test salvage-logging of infested trees as a means of control.

6. Explore the effects of silviculture and management practices on the rate of beetle damage. Some problems needing study are the influence of cutting practices, rotation age, thinnings, age-class composition, and species composition.

7. Study risk and susceptibility. The factors of host resistance need to be studied. These factors include external characteristics of resistant and susceptible trees, the influence of pitch flow, and the genetic differences exhibited by individual trees.

Spruce Budworm

The spruce budworm is a widely distributed and destructive defoliator of Douglas-fir, true firs, and spruce. Outbreaks have been prominent in recent years from eastern Canada and the New England states to the northern Rocky Mountain area, the Pacific Northwest and in New Mexico. Approximately 2 million acres were successfully sprayed in southern Idaho during the period 1955 to 1957.

Research to Date

The spruce budworm has been studied for many years in the eastern United States and Canada. Research was started in Oregon and Washington in 1947 concurrent with a serious epidemic.

Considerable information about the general life history and habits of the insect has been compiled. An aerial survey technique and an effective aerial spray method have been developed. Studies are under way in New England and Oregon to determine effectiveness of natural control factors on the budworm.

Research Needs

Studies in southern Idaho should include:

1. Host relationships of the budworm. The effects of defoliation on individual trees and stands should be investigated. This phase should concentrate on the relationship of defoliation and tree recovery or death, top killing, reproduction, and susceptibility to bark beetles.

Studies of the following phases are planned for Montana and should apply to southern Idaho:

2. Dispersal characteristics of the budworm. Flight habits, flight distance, and distribution within trees and within stands all need study.

3. Natural control factors associated with the rise and fall of budworm populations and damage. This work should include the role of climate and contagious diseases as well as the parasites that have received most of the attention so far.

Mountain Pine Beetle

The mountain pine beetle infests lodgepole pine, limber pine and ponderosa pine in southern Idaho. During several years prior to 1933 more than 75 percent of the mature lodgepole pine in southwestern Idaho was destroyed by this beetle. Today, the ghost-like remnants of the dead trees may still be seen in many areas. Fortunately, severe winter temperatures resulted in cessation of this beetle's spread in 1933. Also, a very favorable circumstance was that a new stand promptly became established following death of the mature trees.

Because the lodgepole tends to grow in even-aged stands and in areas not yet under management, the beetle finds it easy going when conditions favor its increase. Interest in lodgepole pine for pulp and other products appears destined to increase, and damage caused by this beetle will attain added importance.

Research to Date

In areas outside southern Idaho considerable information has been accumulated on the biology and habits of this bark beetle. There is inadequate information concerning its epidemiology and the role of host susceptibility and resistance. Direct control by toxic sprays is available where values justify their use.

The mountain pine beetle has been observed causing heavy damage in second-growth ponderosa pine stands in recent years. Successful management of such stands will require some means of coping with the insect.

Research Needed

Studies in southern Idaho should concern:

1. Determination of effective ways to manage lodgepole pine and young ponderosa pine stands in order to reduce damage caused by the beetle.

2. Epidemiology of the beetle. What are the environmental and natural control factors that underlie changes in beetle populations and damage? What is their importance and how do they operate?

Western Pine Beetle

In ponderosa pine stands this beetle has always been a serious problem. The high value of its host adds to the importance of the damage.

One of the few bark beetles in southern Idaho that produces more than one generation per year, this insect has great potential to rebuild its numbers. When conditions favor an increase in its population the effects of direct control measures are short-lived.

Research to Date

Commensurate with its stature as a tree killer, more research has been done on the western pine beetle than any other forest insect in the West. As a result of past studies, we know much about the insect's life history, habits, and natural control. Direct control measures, which first employed the peeling and burning of infested bark, now consist of penetrating toxic sprays or salvage logging. However, by far the most important development has been the formulation of an indirect means of control. This method, now well tested in eastside stands of California and Oregon, is called sanitation-salvage logging. It removes living high risk trees before bark beetles can attack them. Its success hinges upon the California risk-rating system, which enables foresters to recognize trees of high risk to insect attack. The method has not been tested in southern Idaho, but risk-cutting has been done in some forests. In old growth ponderosa pine it may work, but some modification may be needed because of needle cast and other factors peculiar to southern Idaho.

Research Needs

Studies of this insect should concern:

1. The applicability of the California risk classification and sanitation-salvage logging to ponderosa pine in southern Idaho.

2. Losses in second-growth and cutover stands.

Engelmann Spruce Beetle

Epidemic populations of the Engelmann spruce beetle often build up in windthrown spruce or following logging where excessive slash remains. In recent years several notable outbreaks have occurred in Colorado and Montana. During 1955 heavy mortality occurred on the Bridger National Forest in Wyoming and additional outbreaks have recently developed in Utah. However, it is believed that the limited amount of spruce in southern Idaho and its occurrence as a "stringer type" reduces the damage potential of the beetle.

Research to Date

Considerable research has been carried on in Colorado and Montana during the recent heavy outbreaks. Detailed information has been secured in regard to biology, life history, natural control, and the use of trap trees as a means of direct control. We now know that the insect may have a 1-year, 2-year, or 3-year life cycle depending on location. Length of the life cycle appears to depend somewhat upon temperature. However, two different life cycles may be exhibited by beetles in the same area. We have no knowledge of the possible variations in rate of development common to Idaho.

An interesting recent development has been the use of radioactive isotopes in studying beetle dispersion in Colorado. In these studies, adult beetles were "tagged" with radioactive material and released in large numbers. Scintillators were then used to determine the presence of the tagged beetles in host material at various distances and directions from the release point. These studies have not been completed, but beetles have been recovered at distances up to 3 miles. The results, when available, should be very useful in determining the usefulness of trap trees and their proper distribution for best results. The age-old question "how far do beetles fly?" appears to be answerable at long last. Application of this procedure to studies of other forest insects would provide much needed information.

Research Needs

It is believed that little research is needed on Engelmann spruce beetle in southern Idaho. Because local conditions of altitude and temperatures affect the seasonal history of the beetle, limited studies in Idaho might be warranted to determine whether research results gathered in other areas apply here.

Pine Butterfly

The pine butterfly is a serious defoliator of ponderosa pine and is a real tree-killer during epidemics. It was necessary to spray 255,000 acres of pine in southern Idaho in 1954. The pine butterfly generally appears in epidemic numbers at rather long intervals.

Research to Date

The life history and habits of the pine butterfly in Idaho are known. Observations were made during outbreaks in 1922 and 1923 and during the recent epidemic in 1953 and 1954. A suitable means of determining the need for spraying has been developed. The method involves sampling the abundance of insect eggs during the fall or spring.

An important parasite, Theronia atalantae, has been found to be very effective in causing outbreaks of the butterfly to die out. However, it requires a period of time for this parasite to reach numbers sufficient to suppress butterfly populations. In the meantime, great damage can result. The life history of the parasite is not fully known. Apparently, it spends a part of its life on alternate insect hosts.

Research Needed

Studies should concentrate on these major points:

1. Natural control factors. The roles of climate and predators (especially the parasite, T. atalantae) should be investigated.

2. The effect of differing degrees of defoliation on the host tree should be evaluated.

Pine Engravers

Pine engravers kill young pine stands and the tops of older trees. They constitute a serious problem following logging when populations have built up in slash. As the old growth pine stands become converted to younger stands these insects should attain increased importance.

Research to Date

Considerable work has been done on Ips confusus in California, and some research has been carried on with other species of Ips in other areas. The biology of the pine engravers is fairly well understood and many facts of the insects' ecological relationships have been determined.

Past studies indicate that availability of slash during the growing season is essential to outbreaks of these beetles. They cannot tolerate pitch flow during the growing season and do not establish broods in living trees until growth has slowed. Because these beetles produce several generations per year they can amass tremendous numbers under favorable conditions.

Research Needs

Studies of the pine engravers should include:

1. Appraisal of damage caused by them.

2. Conditions that influence beetle populations.

3. Management practices that would reduce damage to a minimum.

Cone and Seed Insects

Cone and seed insects often destroy a very high percentage of the seed crop by destroying either the cones or the seeds. In any area where natural regeneration of the stand is sought these insects can be especially important. Also, in the process of collecting seed during bumper seed crop years much work is wasted by gathering infested cones.

Research to Date

Over a number of years in California and Oregon numerous data were gathered on cone and seed insects. This has recently been published. Research has been started in several areas of the country in the past few years. Some applications of insecticide have been made in an effort to develop a method of control.

Research Needs

Little is known about damage from these insects in southern Idaho. Studies should be undertaken on the following:

1. Appraisal of the amount of seed destroyed by the various cone and seed insects.

2. Determine the species involved and their abundance.

Wood Products Insects

Wood products insects act from the time logs are created in the woods until put into use as final products. Losses can be enormous due to wastage of material, degrading of lumber, or destruction in use. Wood borers are becoming more important as the salvage of dead timber increases.

Research to Date

Considerable research has been carried on in the eastern and southern United States. Much has been done on the problem of termites; considerable on powder-post beetles in eastern hardwood; and less, perhaps, on ambrosia beetles and other wood destroyers. Salvaged fire-killed

Douglas-fir which was infested with roundheaded borers has given trouble while in use as subflooring in housing projects in California. The best cure seems to be to develop an insecticidal bath in which green lumber may be dipped at the mill. The low value of the infested material has prohibited kiln drying as a control measure.

Research Needed

1. Determine the nature and severity of the problem as a basis for formulating preventive or control practices.

Other Insects

Several other insects occasionally cause significant damage or losses. Among these are the Douglas-fir tussock moth, fir engraver beetle, hemlock looper, lodgepole sawfly, lodgepole needle miner, and others. It is intended only to mention these as possible subjects for research when occasion warrants it. Many of these insects appear cyclically and are subject to control by natural means. The tussock moth, looper, and sawflies should be good subjects for biological control studies.

PARTICIPANTS IN FOREST INSECT RESEARCH PROGRAM

Current

Two entomologists of the Intermountain Forest and Range Experiment Station are assigned to Boise Research Center. These men are responsible for research, insect surveys, and assistance on insect control projects. The time available for research is limited. In order to accomplish as much in research as possible one entomologist will devote most of his time to studying the Douglas-fir beetle. The second entomologist will spend part of his time on research. Some temporary assistants are employed under the direction of the two entomologists.

In addition, private and federal foresters provide detection survey data and assist on damage surveys connected with control projects. However, this assistance could be strengthened with proper direction.

Future

Because many research data must be obtained by a trained forest entomologist, most of the research should be conducted by Intermountain Forest and Range Experiment Station. However, present personnel are not able to cope with the myriad of problems that confront the forest industry in southern Idaho. An eventual increase in staff seems to be the best means of meeting insect problems not being adequately studied at present.

In addition, much helpful information of a survey nature could be rendered by foresters in the area. This information includes the detection of the presence, location of damage, and identity of destructive insects. Also, appraisals of various damage could be made under the direction of the entomologists. Such assistance would improve our knowledge of the amount of damage being caused by insects and would enable the entomologists to devote more of their time to other pressing problems. A further activity that should be explored is the possible use of existing sample plots for the measurement of loss trends in southern Idaho. An inventory of such plots should be conducted and a determination made of the willingness of various agencies to participate. Gaps in existing plot locations might be filled by cooperative effort.

Colleges in the area could give assistance to the program. The University of Idaho could encourage graduate students to study certain aspects of particular insect problems as suggested by the federal entomologists. Provided that the staff were in a position to do so, the University's Department of Entomology could take on a major problem for study.

The Idaho Fish and Game Department and the U. S. Fish and Wildlife Service could determine the effects of insecticides used during control projects on fish and aquatic insects.